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ABSTRACT

This study assessed the influence of test anxiety and self-concept, both independently and in combination, on student test performance across four subject matter areas: (1) English; (2) mathematics; (3) reading; and (4) science. Public high school students (N=217) in northern Oklahoma were administered an American College Testing Program (ACT) assessment, a test anxiety inventory (the worry component of the Test Anxiety Inventory), and a self-concept measure (the Multidimensional Test of Self-Concept). Results indicate that test anxiety and self-concept contribute independently and approximately equally to student academic achievement. In addition, student performance is uniformly affected by test anxiety and self-concept across all four academic areas. These results suggest that successful intervention programs should be oriented toward reducing students' feelings of test anxiety and improving their perceived self-concept. Four tables present study findings, and there is a 37-item list of references. (SLD)

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Effects of Test Anxiety and Self-Concept on Performance Across Curricular Areas

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Abstract

The present study assessed the influence of test anxiety and self-concept, both independently and in combination, upon student test performance across four different subject matter areas. Public high school students (N = 217) were administered an ACT assessment, a test anxiety inventory, and a self-concept measure. The results indicated that test anxiety and self-concept contributed independently and approximately equally to student academic achievement. In addition, student performance was uniformly affected by test anxiety and self-concept across all four content sub-areas. The impact of these findings for theory and academic intervention programs was discussed.

Effects of Test Anxiety and Self-Concept on

Performance Across Curricular Areas

Test anxiety and self-concept have been identified as major variables impacting academic achievement (see Tryon, 1980; Byrne, 1986). Hembree (1988) has indicated that test anxiety, which interferes with performance, is inversely related to self-esteem. Two major issues, however, remain unresolved. The first of these issues involves whether or not these two affective variables are related or independent in their influence upon student achievement. The second issue involves whether or not test anxiety and self-concept differentially influence achievement in various sub-areas of student study (e.g., English, science).

Although the literature generally supports the association between self-concept and achievement, and test anxiety and achievement, research focusing upon the relative influence of self-concept and test anxiety upon achievement has produced indeterminant findings. Several investigations have indicated that self-concept and test anxiety may influence achievement in conjunction. For example, Deffenbacher (1978) and Sarason and Stoops (1978) have indicated that negative self-statements (i.e., low self-concept) may be as critical as anxiety in influencing school achievement. High anxious students have

been reported to produce more negative self-statements, which in turn influences academic achievement (Hammermaster, 1989).

On the other hand, Galassi, Frierson and Sharer (1981) found that there was no correlation between the negative self-statements for either high or low anxious persons and their test performance. It has been suggested that the negative thoughts of high anxious students tend to focus upon the testing situation itself rather than upon themselves (see Wine, 1980). Others (e.g., Bruch, Juster & Kaflowitz, 1983) have indicated that neither the focus of students' self-statements nor their anxiety reactions contributed to test performance. More recently, Williams (1991) has indicated that although test anxiety and self-concept are correlated with adolescent achievement, their contributions were independent.

A second area of controversy in linking self-concept and test anxiety concerns whether or not test anxiety and self-concept contribute in the same manner to different areas of student achievement. Establishing such patterns of achievement requires the measurement of achievement across different subject or content areas. Review articles indicate that most of the past research relating test anxiety to achievement (see Hembree, 1988) and self-concept to achievement (see West, Fish & Stevens, 1980) has typically either used either a single, global measure of achievement, or multiple measures of achievement analyzed

separately. Many of the studies that have compared achievement across subject areas with differences in test anxiety have yielded mixed results. For example, Crocker, Schmitt and Tang (1988) studied the association between test anxiety and academic performance across five different subject areas. They reported similar negative anxiety - achievement relationships across all five content areas. Betz (1978), on the other hand, has cited differences between the impact of student anxiety levels upon student verbal and quantitative performance.

Many investigators have focused upon the anxiety associated with the quantitative subject areas. Test anxiety and mathematics anxiety have been reported to be functionally related (see Hendel & Davis, 1978; Rounds & Hendel, 1980), and related in terms of similarity of components (see Wigfield & Meece, 1988). Thus if mathematics anxiety is one component of test anxiety, test anxiety might differentially impact student performance depending upon the area of achievement that is assessed.

Similarly, different components of self-concept might also differentially impact student achievement. Byrne (1988) has indicated that the relationship between adolescent achievement and self-concept is clearly dependent upon the particular self-concept facet in question. Current measures of self-concept have focused upon the measurement of specific components (see Byrne & Shavelson,

1986). In the popular Shavelson et. al (1976) model, self-concept is hierarchically-ordered, with general self-concept at the apex, moving to self-concept in academic and nonacademic areas, leading to specific sub-areas of self-concept (e.g. English, mathematics, science, physical appearance, peers), and finally to perceptions of behavior at the base. Although Noble and McNabb (1988) have reported that motivational and other affective variables have been significantly related to student achievement scores, researchers seeking to uncover patterns of student achievement across different self-concept levels have typically used the academic self-concept sub-areas. For example, mathematics achievement has been reported to be highly correlated with mathematics self-concept, and less correlated with self-concept in other academic areas (see Marsh, Relich & Smith, 1983). More recently, Marsh (1990) has stated that mathematics and English self-concepts were uncorrelated, despite a significant correlation between achievement in these two areas.

If self-concept becomes increasingly multifaceted from infancy on (Marsh & Shavelson, 1985), with the facets increasingly interdependent (Marsh & O'Neil and Marsh et al., 1984), then corresponding studies into the relatively unexplored components of nonacademic self-concept appear to be warranted.

Purpose of the Study

The purpose of this study was to answer the following research questions:

(1) What is the relative influence of test anxiety and self-concept upon high school students' academic achievement?

(2) Do differences in test anxiety and self-concept result in different achievement patterns across four separate content areas?

(3) Is there an interaction effect of test anxiety and self-concept upon student academic achievement?

The secondary goals of the study were to determine whether differences in self-concept, test anxiety, and achievement existed for different student groups (i.e., gender and class level).

Method

Sample

Participants in this study (N = 217) were high school students attending public schools in northern Oklahoma. Approximately 38% of the sample were seniors, 44% juniors, and 18% "other" (e.g., freshmen, sophomores, exchange students, HS graduates, college students). Students came from urban, suburban, and rural backgrounds, and were primarily middle-class and White. About 62%

of the sample was female (64 juniors, 46 seniors, 24 "other"), with 38% male (32 juniors, 37 seniors, 14 "other").

Procedure

Student data in this study were collected during nine ACT Preparation Workshops sponsored by the Education Extension Office of Oklahoma State University. Student participation was voluntary, with most students referred by school counselors and/or parents. The workshops, conducted both on-campus and at several off-campus locations around the state, consisted of a one-day program of activities to prepare students to take the ACT Assessment examination. During each workshop, students completed three self-administered questionnaires assessing their test anxiety, self-concept, and achievement level. Administration of the instruments was interspersed through-out each workshop.

It should be noted that the data in this study pertained only to high school students attending an ACT preparation workshop. Therefore, the results of the study cannot be claimed to duplicate the results that would have been obtained if data from all high school students were collected.

Instrumentation

Achievement Measures. The ACT Assessment is a comprehensive evaluative, guidance, and placement program used by over a million students each year. The

current study utilized an ACT Assessment practice test (American College Testing Program, 1989) to measure student academic achievement in four major curricular areas: English (23 items), mathematics (20 items), reading (20 items), and science (18 items). Higher student subtest scores indicated a higher measure of overall educational development.

Aiken (1985) has reported adequate internal consistency reliability coefficients for each subsection, [English (.92), mathematics (.91), reading (.88) and science (.85)]. He has also stated that a comparison of item content with item specifications for the four subtests has yielded a substantial degree of content validity.

Test Anxiety Measure. The majority of current test anxiety scales have been designed to assess the two major facets uncovered by test anxiety researchers: worry (the cognitive concerns of testing) and emotionality (physiological reactions to the testing situation). Review articles (e.g., Wine, 1980) have indicated that "worry" has been repeatedly shown to be the most important of the two anxiety components. While "emotionality" has been consistently reported to be unrelated to achievement, there has been abundant research supporting the negative effect of "worry" on achievement (see Tryon, 1980). Thus, for the

current study, the "worry" component of the widely-used Test Anxiety Inventory (TAI) [Spielberger, 1980] provided a measure of student test anxiety.

"Worry" was measured with eight items scored along a Likert-type scale with four answer choices: (1) almost never, (2) sometimes, (3) often, and (4) almost always. Sample items included, "I freeze up on important exams" and "I seem to defeat myself while working on important tests." The minimum possible student score on this subscale was 8, with a maximum obtainable score of 32. Higher student scores indicated a greater amount of test anxiety.

Spielberger (1980) has presented both reliability and validity information for this scale. Internal consistency reliability coefficients of .88 have been reported, as well as test-retest reliabilities of .81 and .62 over two weeks and six months respectively. Correlations of the "worry" scale with six other test anxiety instruments have yielded construct validity coefficients which have ranged from .44 to .79

Self-Concept Measure. Self-concept was measured with The Multidimensional Test of Self-Concept (MTS) [Lathrop, 1988]. This instrument was specifically designed to assess nonacademic self-concept, in contrast to most self-concept measures which stress global or academic self-concept. The MTS taps student self-concept in each of three areas identifed as directly relevant in

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applied settings: sociability, competence, and dependability. Due to empirical considerations, the current study utilized only the "competence" subscale. Hudson (1988) has cited "competence" as the most influential variable in a detailed study of student nonacademic self-concept. Williams (1991) determined that "competence" was the most important self-concept predictor of global student academic achievement.

Self-concept was measured with six items which assessed student perception of current competence. Each item (e.g., "Alert - Unalert", "Inexpert - Expert", "Informed - Uninformed") was scaled along a seven point graphic rating scale, with half of the items reverse-scored. The possible range of student scores on this instrument was from 6 to 42, with higher scores indicating higher nonacademic self-concept.

Lathrop (1987; 1988) has provided support for both the reliability and validity of this nonacademic self-concept subscale. Reliability was assessed three different ways: generalizability coefficients (.78), alpha coefficients (.73), and test-retest stability coefficients with a three-month delay (.71). Confirmatory factor analyses and correlational analyses with other established self-concept measures have been cited in support of the construct validity of this subscale.

Results

Initial Analyses. Descriptive statistics were generated across all six variables of interest: achievement (English, mathematics, reading, science), self-concept and test anxiety. These descriptive statistics are presented in Table 1. As noted

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Insert Table 1 about here

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there, although the standard deviations across the four achievement measures were fairly consistent (a range from 3.23 to 4.47) the mean scores varied somewhat. As one might expect, both mathematics and science scores were lowest for this sample (about 10 points each), with reading (about 13) and English (about 18) the highest.

Groups Differences. Analyses of variance were conducted to test for possible test anxiety, self-concept, and achievement differences based upon gender and class level student groupings. These analyses were conducted to determine whether the sample used in the current study exhibited the pattern of results typically reported by other researchers. For example, research has indicated that test anxiety has remained fairly consistent through high school, with higher levels of test anxiety associated with female students (see Hembree,

1988). Studies focusing on adolescent gender differences in academic self-concept have also generally reported consistent findings. Males have typically exhibited higher quantitative self-concept while females have exhibited higher verbal self-concept. At the high school level, females have tended to have higher performance levels than do males (Byrne & Shavelson, 1987). In addition, due to additional instruction, seniors might be expected to outperform juniors on achievement tests.

A two-factor ANOVA was conducted to test for possible student differences in test anxiety. Test anxiety scoresserved as the dependent variable, with students nested in both gender group (male or female), and class level (junior, senior, or "other"). The second analysis was conducted in a similar manner (i.e., the same grouping variables), with student self-concept scores serving as the dependent variable. No statistically significant differences were detected in either analysis (see Table 2 for the means within each cell).

Insert Table 2 about here

A third ANOVA was performed with students nested in both gender and class level, with the four student achievement subscales used as repeated

measures. This analysis resulted in a statistically significant main effect for "Class level" [F(.05;2,211) = 4.18], and a significant interaction between "Gender" and "Achievement" [F(.05;3,633) = 5.78]. However, omega-squared values of only .01 were computed for both effects, indicating only minor practical differences. As a consequence, the student data were collapsed across gender and class groups, and the remainder of the analyses which addressed the major research questions central to this study were conducted on the full student sample.

Interaction Analyses. The analyses to answer the major research questions of this study proceeded from the specific to the general. Therefore, the issue of interaction between test anxiety and self-concept upon student achievement scores was addressed first. Four sets of two multiple regression analyses were conducted to answer the interaction question. The format of these analyses for the English subtest Achievement variable was:

(1) English = f (Test Anxiety + Self-Concept)

(2) English = f (Test Anxiety + Self-Concept
+ Test Anxiety x Self-Concept)

Similar analyses were conducted for the remaining three Achievement subscales. The incremental R-squared values (e.g., R^2 equation 2 minus R^2

equation 1) for the interaction terms are shown in Table 3. The associated values of W (Pedhazur, 1982; pp. 618-620) are also shown in Table 3. These W values

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Insert Table 3 about here

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test the significance of the difference between the two prediction equations for each achievement variable. As noted there, the p-values associated with the interaction term across the four content sub-areas ranged from .40 to .80. This indicated the absence of any significant interaction effect between test anxiety and self-concept across all content areas. It appeared that test anxiety and self-concept contributed relatively independently to student achievement.

Content Area Analyses. The second research question addressed in this study, the issue of pattern differences, was simplified since the interaction terms were non-significant in each of the four cases (see equation (1) above). The four sets of beta weights for both affective variables were examined (see Table 4).

Insert Table 4 about here

At first glance, these results seemed to indicate a pattern quite opposite to that predicted by the literature. It appeared that self-concept had a greater impact on mathematics and science, while test anxiety had a greater effect on English and reading. All possible pair-wise differences between the Test Anxiety beta-weights were tested. Adjusting for multiple post-hoc comparisons (see Keppel, 1982; pp. 153-157), none of these differences were statistically significant. Similar analyses were conducted between the four beta-weights for Self-Concept. Again, none of these differences reached a level of statistical significance. Each of the two affective variables appeared to uniformly affect student performance.

Relative Influence Analysis. Since both variables had a homogeneous effect across all four content areas, a single principal component score was calculated for each student. These principal component scores were generated to yield a single accurate index of "student achievement". The achievement score was derived from the first factor from a principal component analysis. This analysis indicated that the first eigenvalue accounted for the majority (65.4%) of the variance of the entire set of scores. Relatively small and equal variances (about 12%) were detected in the remaining three components. The equation for the first principal component was:

$$\text{Achievement} = .833\ \text{English} + .783\ \text{Mathematics} + .805\ \text{Reading} + .813\ \text{Science}$$

It appeared, from this equation, that each of the content areas contributed about equally to the final achievement score earned by each student.

This achievement score was then regressed upon the student test anxiety and self-concept scores. The results of this analysis yielded the following standardized prediction equation:

$$z_{Achievement} = -.263\ z_{TA} + .230\ z_{SC}$$

The multiple R value for this analysis was .382, with an associated F-value (d.f. = 2, 214) of 18.28; $p < .001$. The t-values (d.f. = 214) associated with the beta weights for both test anxiety and self-concept were also statistically significant ($p < .001$). It was apparent that these two affective variables contributed approximately equally to the prediction of student academic achievement.

Discussion

As anticipated, the results of the current study indicated that students who reported higher self-concept and lower test anxiety also had higher achievement scores across all four content sub-areas. This finding was consistent with Dweck's (1986) conclusion that test anxiety and negative self-concept had profound effects on cognitive performance. It should be noted, however, that

students in the current study anticipated being college-bound or participated in the workshops at the urging of their parents and/or school counselors. In addition, the students may not have taken the "practice" achievement test seriously, and therefore their scores may not be reflective of their "true" ability. Thus, the current findings may not be totally generalizable to the actual performance level of all high school students.

It is perhaps unusual to formulate theoretical constructs based upon statistically non-significant results. The non-significant interaction and content area analyses presented here might have arisen from a variety of causes: insufficient sample size, unreliable test instruments, sloppy procedure, etc. However, it appeared unlikely that these factors influenced the current findings. The power in this study, given the 217 subjects tested, would appear to satisfy large sample requirements. Secondly, all three test instruments utilized were well within the bounds of accepted reliability (achievement - .85 to .92; test anxiety - .88; self-concept - .78). Finally, had poor method been used then neither the overall regression equations nor the two standardized regression coefficients would have reached statistical significance ($p < .001$) as reported in these analyses. Thus, it appeared that the findings from the content area and the interaction analyses could be interpreted with some degree of confidence.

The finding of no significant curricular area pattern differences related to either test anxiety or self-concept was surprising. Researchers assessing both mathematics and test anxiety have reported moderate correlations between the two constructs (see Betz, 1978), and have indicated that it is often difficult to distinguish between the two (see Wigfield & Meece, 1988). If these findings could be generalized to the current study, one would have expected a greater impact of test anxiety on the sub-areas of mathematics and science than upon English and reading. Additional research relating mathematics anxiety and its components to test anxiety appears to be warranted.

The finding of non-significant pattern differences is also in direct contrast to the conclusions of Byrne and Shavelson (1986), and Marsh and Shavelson (1985). They related curricular area achievement to specific corresponding sub-areas of academic self-concept. However, given the Self-Perception model of personality developed by Bem and Allen (1974), one may question whether or not "self-concept" was actually being measured in their studies. A question such as "How good are you in Math?" would appear to be simply a veridical report based upon ample prior evidence (i.e., the scores previously obtained on mathematics tests).

Finally, the current results have indicated that test anxiety and self-concept appeared to have a ubiquitous, non-interactive effect upon all four areas of student performance assessed. The impact of such a conclusion upon programs for academic intervention is striking. The present study suggested that successful intervention programs should be oriented towards reducing feelings of test anxiety and improving perceived self-concept. For example, Wilson and Rotter (1986) studied the effects of five different treatment intervention conditions upon both test anxiety reduction and self-esteem enhancement. They have indicated that a counseling approach to test anxiety, with ego-strenghtening suggestion and study-skills development, produced the greatest long-term effect upon changing both test anxiety and self-esteem. It should be noted, however, that their study involved only individuals classified as "high test anxious." The present study would appear to extend their conclusion, in that student test anxiety and self-concept scores were not artificially categorized but were permitted to vary across all values from low to high. Additional follow-up studies testing paradigms such as that proposed by Wilson and Rotter should be conducted using all the information provided by continuously-scaled affective measures.

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Table 1

Descriptive Statistics for Total Student Sample (N = 217)

Variable	Mean	Standard Deviation	Range
English	17.76	4.13	4 - 23
Mathematics	10.35	4.47	1 - 20
Reading	12.65	3.64	3 - 20
Science	9.86	3.23	3 - 18
Self-Concept	33.15	3.95	17 - 41
Test Anxiety	14.47	4.36	8 - 20

Table 2

Gender and Class Level ANOVA Means

	A			B		
	Test Anxiety			Self-Concept		
	Junior	Senior	Other	Junior	Senior	Other
Male	14.75	14.16	14.86	32.69	33.86	32.57
Female	13.89	15.28	14.38	33.31	33.11	32.67

Table 3

Incremental R^2 Values Associated with the Test Anxiety x Self-Concept Interaction

	Significance test for Goodness of fit	
Dependent Variable	Change in R-Squared	W
English	.00058	.056 (p = .80)
Mathematics	.00689	.716 (p = .40)
Reading	.00062	.066 (p = .80)
Science	.00137	.141 (p = .70)

Table 4

Standardized Regression Coefficients for Affective Variables

Dependent Variable	Test Anxiety Beta weight	Self-Concept Beta weight
English	-.245	.149
Mathematics	-.143	.237
Reading	-.324	.179
Science	-.137	.180